PRICE $5.00

POWER SUPPLY

INSTRUCTION MANUAL

kepco inc.®

131-38 SANFORD AVENUE • FLUSHING 52, N. Y.
Area Code 212 IN 1-7000 • TWX # NY 4-5196

INSTRUCTION MANUAL:

MODEL SC 32-15A

SERIAL NO. C.34334

KEPCO, INC.
131 - 38 Sanford Avenue
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Kepco, Inc.
Flushing, New York

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SECTION A SPECIFICATIONS AND CONTROLS

I. ELECTRICAL AND PHYSICAL SPECIFICATIONS:

....DC OUTPUT VOLTAGE:
Q-32 volts DC, continuously variable.

....DC OUTPUT CURRENT:
0-15 amperes, continuous duty.

....AC INPUT:
105-125 volts, 50-65 CPS.

....REGULATION:
Line: Less than 0.01% for AC line fluctuations from 10-125 volts at any output voltage in the specified range.
Load: Less than 0.01% or 0.002 volts, whichever is greater, for 0 to 15 ampere step load change, at any output voltage in the specified range.

....RIPPLE:
Less than 0.001 volt rms.

....STABILITY:
Output variation is less than 0.01% or 0.002 volt, whichever is greater, over a period of 8 hours after unit has reached equilibrium. Approximately 3/4 of an hour is required for this unit to reach equilibrium from a "cold start". Drift during warm-up is less than 1%.

....OUTPUT IMPEDANCE:
Less than 0.001 ohm from DC to 1 KC.
Less than 0.01 ohm from 1 KC to 100 KC.

....RECOVERY TIME:
50 microseconds.

....TEMPERATURE COEFFICIENT:
Output voltage changes less than 0.01 per ^{o}C.

....AMBIENT OPERATING TEMPERATURE:
-20^{o} C to 50^{o} C maximum. Protective circuit turns off unit whenever over-temperature condition occurs. Interrupting input power resets unit.

....STORAGE TEMPERATURE:
-40° C to +85° C.

....*METERS (If specified):
Voltmeter: 0-50 volts, 2-1/2".
Ammeter: 0-15 amperes, 2-1/2".

....DIMENSIONS:
Height 8-3/4", width 19", depth 14-3/8".

....COLOR:
Kepco standard gray hammertone.

II. TERMINALS AND CONTROLS:

....(On front panel):

....DC OUTPUT AND GROUND binding posts, clearly marked. Output terminals isolated from chassis; either positive or negative terminals may be grounded.
....VOLTAGE CONTROL continuously variable, one turn, for setting the desired output voltage.
....POWER ON-OFF toggle switch.

....(On terminal board at rear of unit):

....DC OUTPUT AND GROUND terminals, clearly marked; either positive or negative output may be grounded.
....REMOTE ERROR SIGNAL terminals provide means of maintaining specified regulation directly at the load by compensating for voltage drops across load supply leads. (See Diagram and Procedure on Page C-1).

....(On Control Unit, Tram 8, at rear of unit):

....MAXIMUM CURRENT ADJUST (MC): This adjustment is factory-set to automatically limit the output current to 120% of its maximum rating. If a current limiting effect is introduced by the voltage drop across the load supply leads, when using remote error sensing, the Maximum Current Adjust may be set clockwise to compensate for this effect. Care should be taken to see that this control is returned to its normal setting for standard operation.

III. PROTECTIVE FEATURES:

....SHORT CIRCUIT PROTECTION:
When the load exceeds the maximum permissible output current by 20% the limiter amplifier automatically increases the impedance of the series pass transistors, so that their dissipation rating is never exceeded.

....FUSE PROTECTION:
INPUT FUSE on front panel.
REFERENCE FUSE on rear apron of chassis.
POT FUSE on rear apron of chassis. This fuse has been designed into the circuit to protect the 10 turn voltage control in the event of any internal failure or accidental removing of jumper bars on the rear terminations when the unit is operating.

SECTION B.

THEORY OF OPERATION

This power supply is of a servo or closed loop design in which the pass elements are in series with the load. (See block diagram B-1).

The voltage drops in the closed loop system are automatically adjusted according to the comparison of a sample output voltage with the reference voltage in the CONTROL UNIT. The differential product of this comparison is amplified and fed back as the ERROR INPUT to control the voltage drop across the pass transistors. The ERROR INPUT to the PASS CIRCUITRY is a negative or degenerative feedback signal. Consequently, the voltage drop across the pass transistors is such as to oppose output voltage change.

CAPITALIZED TERMS ADOPTED FOR FOLLOWING OUTLINE AND DISCUSSION REFER TO DESIGNATIONS ON THE CIRCUIT SCHEMATICS IN THE REFERENCE INDEX.

.....1. POWER UNIT (Circuit Schematic Tile)

A. INPUT CONTROL CIRCUITRY - Controls power input from the line to the DC SOURCES.

B. DC SOURCES - Provide main and auxiliary rectified power for all DC circuitry.

C. PASS CIRCUITRY - In the MAIN DC path to the output. All current drawn by the load goes through the pass elements, hence the name.

.....II. CONTROL UNIT (Circuit Schematic Tile)

A. REFERENCE VOLTAGE CIRCUITRY - Maintains a stable voltage standard for the comparison circuitry.

B. THE COMPARISON AMPLIFIER - Functions as the "error sensing" and cascade amplification circuit.

.....III. COMPARISON BRIDGE -

Consists of elements in both the POWER UNIT and CONTROL UNIT in a circuit configuration which effects a comparison between an output voltage sample and a stable reference voltage.

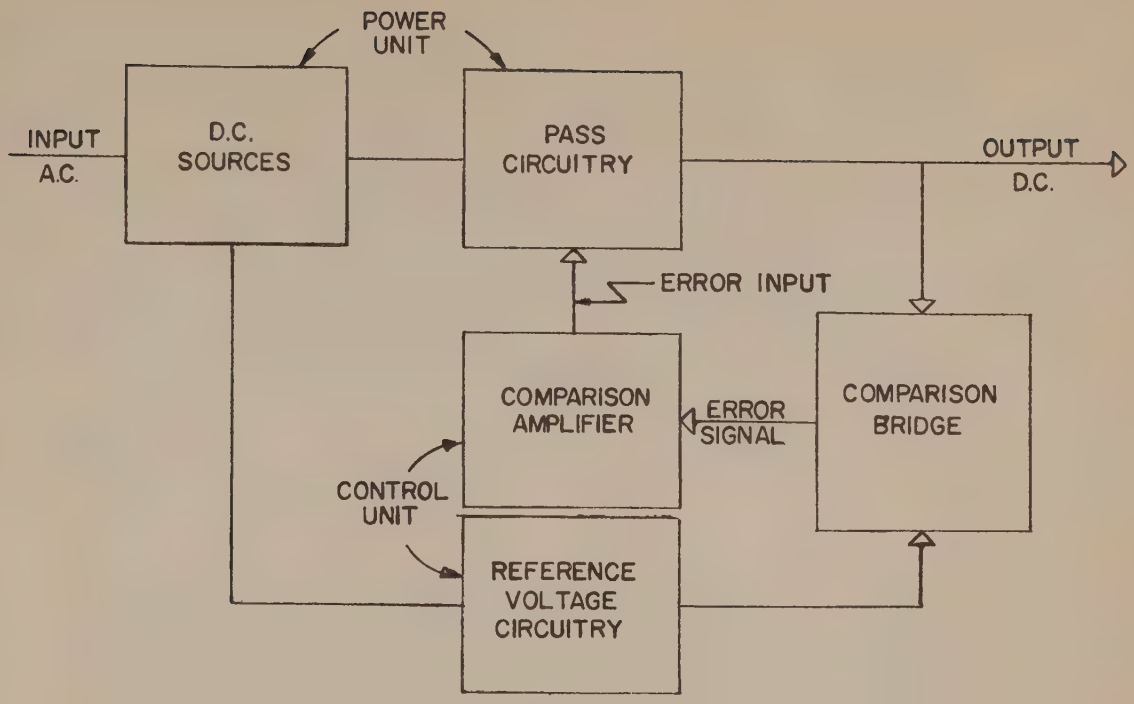


DIAGRAM B-1

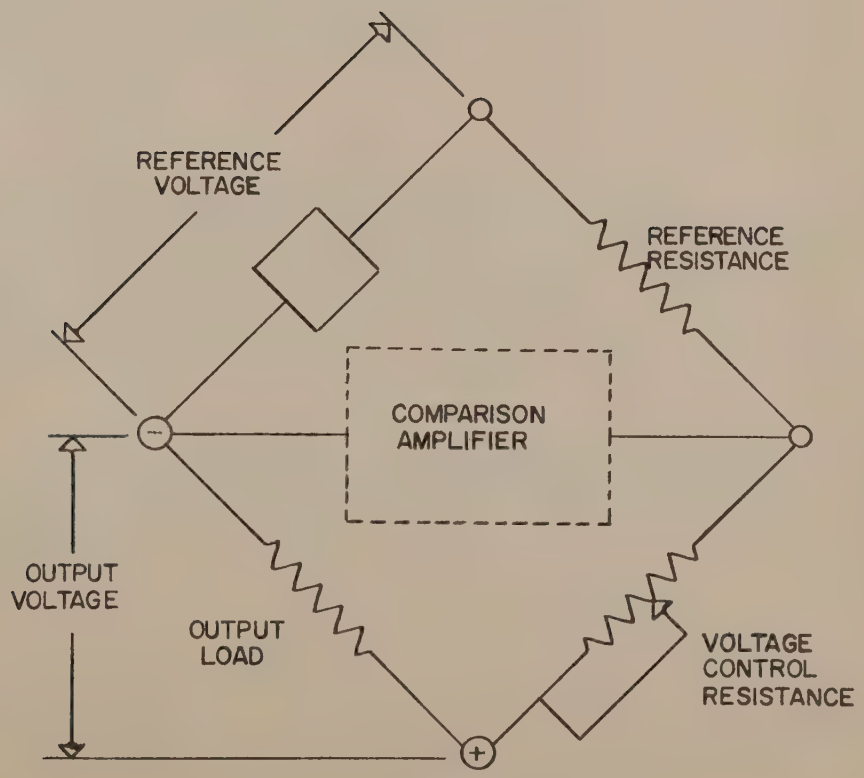


DIAGRAM B-2

NOTE:

The following discussion describes the elements of the foregoing outline in greater detail. As before, capitalized terms refer to designations on the schematic diagrams. Some of this discussion is of a general nature and may not apply in every detail to this specific model. Variations in the basic outline occur primarily in connection with the PASS CIRCUITRY INPUT CONTROL CIRCUITRY or the REFERENCE VOLTAGE CIRCUITRY and reflect design considerations relevant to the particular output requirements of the model. It should not be assumed that a set of circuit schematics is incomplete because it does not include all of the reference nomenclature used in this discussion.

I. POWER UNIT

A. INPUT CONTROL CIRCUIT:

(1) With the input switch closed, a forward bias on one semiconductor diode in the ENERGIZING CIRCUIT will draw a charging current for the capacitor which energizes the INPUT RELAY coil closing the input to the DC SOURCES transformers. As soon as the INPUT RELAY is closed, the DC in the input control circuit circulates through the thermal relay and input relay coil, bypassing the charged capacitor and holding the relay closed.

(2) If the pass element containing the thermostat control becomes overheated, the thermal switch opens the DC path to the INPUT RELAY de-energizing the relay coil and cutting off the input to the DC SOURCES.

NOTE:

The AC line power must be interrupted in order to reset the input relay after the thermal switch has opened the input to the DC SOURCES. Once the capacitor in the ENERGIZING CIRCUIT is charged, it cannot hold the relay when the thermal switch opens. This action tends to prevent damage to the pass elements from overheating in case the transistor associated with the thermostat dissipates heat faster than the other pass elements.

(3) When the input relay is opened by the action of the thermal switch or by pulling the line cord, the DISCHARGE RESISTOR effectively shorts the MAIN FILTER CAPACITOR preventing overvoltage surges.

B. DC SOURCES:

(1) RETURN SUPPLY (full wave rectified and filtered) - provides a return path for leakage current (I_{CO}) from the pass transistors.

It is also a bleed path which provides a minimum operating current for the emitters of the pass transistors, enabling them to continue to remain operative or "sensitive" to the ERROR INPUT when the load current becomes zero or vanishingly small.

(2) MAIN SUPPLY (full wave rectified and filtered) - provides MAIN DC for the output, subject to the regulatory action of the PASS CIRCUITRY. The MAIN DC path includes the pass elements and the load in series.

(3) I_{CO} SUPPLY (full wave rectified) - Provides a supply of current to prevent spurious biasing of the pass transistors by collector leakage current (I_{CO}). I_{CO} generated as a function of temperature and flowing oppositely to the emitter base current tends to alter the ERROR INPUT unless this compensating supply provides bias stabilization.

(4) COLLECTOR SUPPLIES (negative half-cycle rectified) - provide proper collector bias for the PRE-DRIVERS.

C. PASS CIRCUITRY:

The power transistors which function as pass elements may be regarded as electronic variable resistors (or variable conductors) controlled or "varied" by an amplified ERROR INPUT. The amount of current "passed" by these transistors is a function of the magnitude of the forward conducting emitter-base bias. Since the ERROR INPUT is applied to the base terminal, a negative input will aid the forward conducting bias of a PNP transistor while a positive input will reduce the forward conducting bias. In response to the polarity and magnitude of the ERROR INPUT, the pass transistors control the current and voltage distribution in the MAIN DC loop and effect a constant output voltage.

Two main classifications of pass transistors may be indicated on the schematic acoording to the way in which they are driven:

(1) DRIVEN PASS - "driven" by the ERROR INPUT from the CONTROL UNIT. A DRIVER and a PRE-DRIVER may be connected in cascade with the DRIVEN PASS. These amplification stages increase the response and sensitivity of the system to cutput voltage changes. The DRIVEN PASS may be a single series pass transistor

or a series pass group of transistors connected in parallel for increased current capacity.

(2) SLAVE PASS - found in transistorized units requiring more than one series pass group in the MAIN DC path. These pass transistors "slavishly" follow the response of the DRIVEN PASS to the ERROR INPUT. The SLAVE PASSES are driven through a SLAVE VOLTAGE DIVIDER which effects an approximately equal voltage division among the series pass groups in models where the voltage range requires more than one group of series pass elements. The SLAVE PASSES may or may not have preliminary amplification stages in cascade.

When series pass groups contain transistors connected in parallel, an EQUALIZING RESISTOR is associated with each transistor. These EQUALIZING RESISTORS, tied to each emitter, provide a means of compensation for intrinsic differences among transistors within a pass group.

The expression "drop voltage" is sometimes used to describe the amount of voltage drop required of the pass elements to bring the COMPARISON BRIDGE into balance. This is the difference between the input and the desired output. True balance or stability is inherently impossible in a servo system, but the unbalance may be reduced to as small a magnitude as desired in a dynamically corrective system.

II. CONTROL UNIT

A. REFERENCE VOLTAGE CIRCUITRY:

The function of the REFERENCE VOLTAGE CIRCUITRY is to maintain a precise, stable voltage for the COMPARISON BRIDGE. This is normally achieved according to the model CONTROL UNIT with either of two basic design approaches:

(1) A CASCADE ZENER REFERENCE, consisting of Zener diodes of succesively decreasing values in cascaded stages each of which produce an increasingly regulated reference voltage. In practice, usually only two stages are used so that in effect the first Zener diode is a regulator for a voltage reference diode.

(2) Balanced amplifier regulation - Any disparity between the bases of the transistors in the set of 1st BALANCED AMPLIFIERS is coupled to the set of 2nd BALANCED AMPLIFIERS. The 2nd BALANCED AMPLIFIERS couple this amplified "error signal" to a REFERENCE DRIVER and a REFERENCE PASS which regulate the current through a REFERENCE DIODE in a manner analogous to the action of the PASS CIRCUITRY in the POWER UNIT.

B. COMPARISON AMPLIFIER CIRCUITRY:

(1) The COMPARISON AMPLIFIER consists of a series of cascaded transistor amplifiers which boost the "error input" to a sufficient level to drive the PASS CIRCUITRY in the POWER UNIT.

(2) The COMPARISON AMPLIFIER is connected across the COMPARISON BRIDGE from the junction of the VOLTAGE CONTROL and the REFERENCE RESISTANCE to the junction of the Zener reference diode and the negative output terminal. (See Diagram B-2). This arrangement is similar to that of the null galvanometer across a Wheatstone bridge. The unbalance in the COMPARISON BRIDGE is detected and amplified by the COMPARISON AMPLIFIER CIRCUITRY beginning a chain of circuit responses which produce an ERROR INPUT signal of proper phase and magnitude to effect corrective action by the pass circuitry.

.....III. Comparison Bridge:

(1) This bridge circuit implements the comparison between the OUTPUT VOLTAGE and the REFERENCE VOLTAGE. The signal produced by the comparison drives the COMPARISON AMPLIFIER CIRCUITRY.

(2) The Comparison Bridge is represented schematically in Diagram B-2.

(3) Balance occurs in the Comparison Bridge when the following ratios are equal:

$$\frac{\text{Output Voltage}}{\text{Voltage Control Resistance}} = \frac{\text{Reference Voltage}}{\text{Reference Resistance}}$$

(4) When the Comparison Bridge is unbalanced by a decreasing output voltage drop across the load, it gives rise to a negative bias at the base of the COMPARISON FOLLOWER in the COMPARISON AMPLIFIER CIRCUITRY. This signal, amplified, acting as the ERROR INPUT negatively biases the base of the DRIVEN PASS, aiding its forward conducting bias and increasing the output voltage.

(5) A bridge unbalance caused by an increasing output voltage produces, of course, a chain of oppositely biased circuit responses which reduce the voltage across the load.

THIS POWER SUPPLY:

....is shipped without any internal packing material and may be put into operation right away.

....is designed for rack or bench use. Carrying handles are provided on front panel.

....incorporates carefully selected and tested components which assure long trouble free operating life. However, resistor board construction and plug-in sub-assemblies provide exceptional component accessibility should servicing be required. Any servicing should be handled by personnel experienced in transistor circuitry. Serious and costly damage can result from inexperienced probing.

....should not be returned to the factory without proper authorization and shipping instructions. In any correspondence with the factory concerning repair, the model and serial number of the instrument must be supplied together with a description of the trouble encountered.

INITIAL "TURN-ON" PROCEDURE:

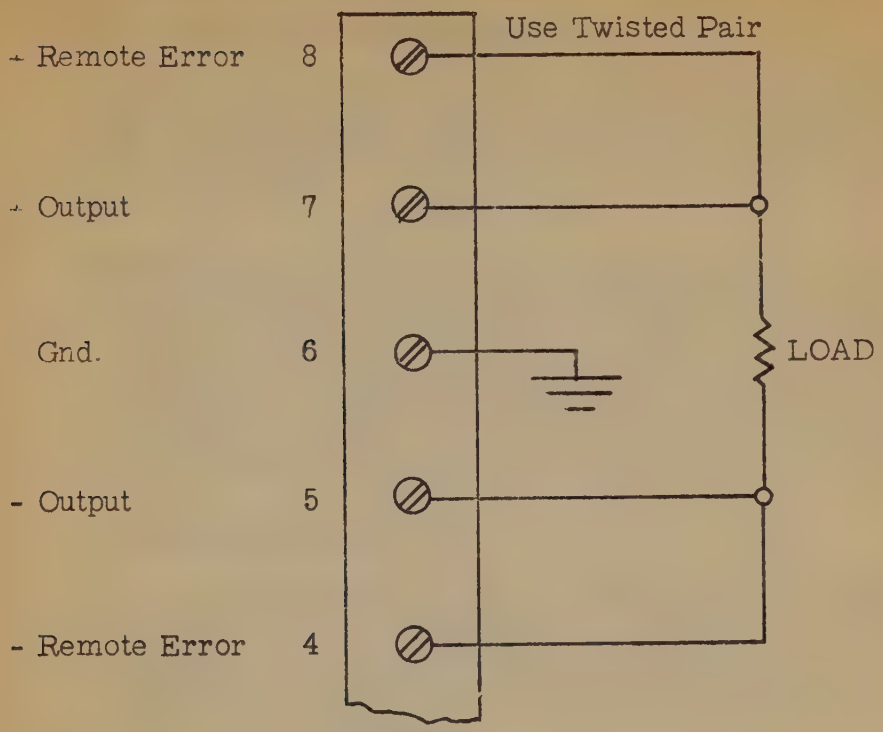
1. Rotate voltage control to approximate mid-range position.

2. With power ON-OFF switch in "OFF" position, plug line cord into 115 VAC 60 cps power receptacle. If the outlet is not polarized, use 3 to 2 prong adaptor supplied with unit.

3. Turn power ON-OFF switch to "ON" position.

4. Set output voltage to desired value by rotating voltage control.

REMOTE ERROR CONNECTIONS



FIGURE

1. With A.C. input power disconnected, remove jumpers between OUTPUT terminals and REMOTE ERROR SIGNAL terminals (terminals 4 and 5, 7 and 8).

2. Using twisted pair wire, connect sensing leads from positive and negative REMOTE ERROR SIGNAL terminals (terminals 4 and 8) to the load (observe polarities).

3. Using twisted pair wire, connect load supply leads from positive and negative OUTPUT terminals (terminals 5 and 7).

SECTION 4
MAINTENANCE AND REPAIRS

4-1 GENERAL INFORMATION. -

The performance of this Power Supply will in a sense be dependent on the collective performance of all of its components. Kepco chooses and tests these components to provide long life and trouble-free operation of the unit.

However, if component failure should occur, it is recommended that troubleshooting be handled by personnel familiar with transistor circuitry, preferably with experience in feedback regulator design. The essential regulating circuitry is a closed-loop DC servo system. The same circuit sensitivity which enables a high degree of regulation to be obtained also increases the susceptibility of the circuit to interrelated functional disorders if the equipment is improperly serviced.

....REFERENCE MATERIAL. -

The Instruction Manual furnished with the Power Supply is identified with the serial number of the unit, assuring that the information it contains is correct and current for the unit to which it applies. The following reference material is provided in the Manual to aid in troubleshooting and repairs:

1. Large schematic diagrams showing essential voltage measurements and component values.

2. Parts location photos or drawings.

3. Parts lists identifying all replacement parts with description and specifications, and the name and manufacturer's part number of at least one replacement source for each item.

....FACTORY REPAIRS. -

If it becomes necessary or desirable to return the equipment to KEPCO for servicing, it should not be shipped to the factory without the sender having prior authorization and shipping instructions. The inclusion of detailed information with the unit, or in correspondence preceding its return to the factory will greatly expedite completion of repairs and return of the equipment to the sender.

In any correspondence with the factory about this Power Supply, the model and serial numbers should always be included.

4-2 MAINTENANCE. -

Under normal operating conditions, only a minimum of maintenance may be required.

1. Fan Assemblies. - If the unit is equipped with muffin-type fan assemblies (black impeller, motor enclosed in hub), this type is permanently lubricated by the manufacturer and does not require relubrication. The open frame type of motor may be lubricated lightly every six months.

2. Brushes. - In units that contain a variable transformer, the brush assembly should not as a rule ever require maintenance or replacement. If it is desired to clean the commutator track, use only a soft cloth moistened lightly with an electrical cleaner (not a solvent). Never use any type of abrasive material on the track.

3. Vacuum Tube Replacement. - Vacuum tubes may be replaced as required when they become defective, or at arbitrary intervals of either life or use. Unless specifically indicated, tubes may be replaced individually and need not be replaced in sets or groups.

4. Performance Tests. - If the unit is to be tested and measured to determine its performance with respect to Regulation, Ripple, etc., the section in the Manual on Regulation Measurements should be read, and the recommended procedures contained therein, or their equivalent, should be followed to aid in obtaining accurate test measurements.

....PRELIMINARY TROUBLESHOOTING CHECKS. - Before proceeding with any extensive electrical troubleshooting, it is advisable to carefully check the Supply for any operational or mechanical disorders.

1. Check for broken, loose, or shorted terminals, wires, and connections; loose connectors, open or loose fuses, tripped circuit breakers, etc. Check all internal as well as external fuses.

2. If the malfunction relates to an overtemperature condition, check to see that the fans work properly and that the openings weren't blocked during operation. On units with overtemperature protection be sure to allow enough time for the thermostat switch to cool and to restore to normal position.

3. Check all operational functions and controls for proper settings. For example, on units with automatic current limiting, a low current setting can, under certain conditions, have the effect of limiting the output voltage, which may appear to be a malfunction. Check to determine whether any internal adjustments may have been reset for any reason, and left at a setting that is incorrect.

4-3 NOTES ON TRANSISTOR SERVICING TECHNIQUES.

....MECHANICAL.

1. A transistor should not be disconnected from, or connected to its circuit while voltage is still present in the circuit.

2. When a soldering iron must be used to remove or install a transistor, or a diode, the heat of the iron while it is being applied to the terminals will almost certainly damage the component unless precautions are taken to prevent it:

   a. When soldering, always apply a temporary "heat sink" to the leads between the iron and the semiconductor to drain off the heat travelling up the lead.

      Note: Pliers are often used for this purpose - be sure they are effective; e.g., flat blade "duck-bills" are good, narrow blade or "toothed" long-nose pliers may be poor.

   b. Solder quickly, so as to limit the application of heat to the briefest possible duration. In this respect use a good iron with proper and sufficient heat for the connection. An iron of too low heat tends to require longer application.

3. When removing or installing a transistor or a diode which has its case connected to one of its elements, be sure to preserve the arrangement of any insulating materials, such as mica washers or bushings.

4. When installing plug-in transistors which have flexible leads, be sure to align the leads and socket pins properly; especially in the "universal" sockets which were designed to accommodate more than one lead pattern.

....ELECTRICAL.

1. Transistor Testers. - Transistor checking instruments, either commercial types or those of local design, may be used. These are usually effective and practical, but not in every case, depending on many circumstances including the accessibility of the unit under test, and the range of the instrument.

2. In-Circuit Analysis. - In some cases the condition of a transistor may be determined by observing certain of its electrical characteristics while it is operating in the circuit. These may range from voltage readings to AC analysis with an oscilloscope.

3. Ohmmeter Check. - Transistor failures of a more complete nature such as shorted or open junctions may be easily detected by test with an ohmmeter. However, some precautions are necessary:

   a. Use the low ohms scale only (Rx1), and then only if the source voltage of the meter (battery) is not more than 2 volts. The use of a higher range or one with high battery voltage may give erroneous indications and might even damage a transistor.

   b. The "common: or black terminal on most ohmmeter instruments is the Positive terminal of the ohmmeter battery, not negative as is commonly believed. When checking semiconductors with an ohmmeter it is usually necessary to know the polarity of this voltage in order to interpret the readings obtained. Some manufacturers of ohmmeters are now indicating this polarity on their meters.

   c. An ohmmeter test between any two terminals of a transistor indicates by the needle deflection whether it is conducting ohmmeter current between those two terminals; and the amount of deflection is related to the amount of this current and to the voltage drop developed across the junction. The actual reading in ohms is not as significant as are other conclusions from the readings. With the polarity of the meter applied as a forward bias to either the base-emitter or base-collector junction, forward current should flow with the needle deflecting on the order of 5-50 ohms; with the polarity reversed in either case, only leakage current flows with little or no perceptible deflection. In both cases the apparent ratio between readings of opposite applied polarity should be on the order of at least 100 to 1. A reading between emitter and collector should be high in both directions.

   d. When an ohmmeter is used to test a transistor that is still in the circuit, the parallel effects of other components in the circuit should be taken into consideration.

4. Substitution. - The above procedures are very often used to localize a trouble down to a circuit area or to one component with final proof dependent on substituting a known good component. It is possible for one bad transistor in a circuit to "pull" another one with it. When a transistor is found to be defective, it should not be replaced before all others have been checked, including those which would appear to be not directly associated in the circuit with the defective one.

....DIODES.

1. Most of the preceding material on transistors is applicable to diodes, except that diodes are two terminal devices consisting of a single junction. The ratio of "front to back" readings on an ohmmeter should similarly be on the order of 100 to 1.

2. When replacing diodes, be sure to observe the proper polarity:

   a. The "triangle" of a diode symbol represents the anode and "points" in the direction of forward conduction under conditions of applied forward bias.

   b. Diodes are marked with their polarity in terms of their output and the cathode is marked positive (+).

....ZENER DIODES.

1. Zener diodes may be checked with an ohmmeter provided they are of a single junction type. Double anode types have a common cathode which is not brought out to a terminal. Thus, whichever polarity of the ohmmeter is applied to the two anode terminals, it will read a high resistance reverse bias in both directions. A short however, can be detected. Manufacturers are not yet consistent in their marking of polarity on Zeners; before disconnecting a Zener, be sure to note its markings with respect to the terminals to which it is connected.

2. A positive test of a Zener diode is to measure the voltage across it while it is in operation. If instrumentation is available, the voltage regulation across its terminals should be measured and compared to its ratings.

4-4 POWER SUPPLY MEASUREMENTS. -

....DEFINITIONS -

Line Regulation. - Stated in percentage of the output voltage, Line Regulation specifies the maximum amount that the output voltage will change as the result of a specified change in line voltage, with the load maintained at a constant value.

Load Regulation. - Stated in percentage of the output voltage (or in actual value) specifies the maximum amount that the output voltage will change as the result of a specified change in output load current, with the line voltage maintained at a constant value.

MEASURING REGULATION. -

Load Regulation and other performance characteristics can be measured at any point in a system. However the results obtained will apply only to the specific point at which they are measured, and may differ from what is specified for the output of the Supply. If it is desired to measure or to verify the performance of the Supply itself, the measurements should be made at the terminals on the Supply, using instrumentation and procedures that are capable of measuring with the desired accuracy.

As an example, consider a Kepco Model SC 32-5, 32 volt/5 ampere Supply which has 0.01% regulation. At 32 volts, the output voltage at the terminals will not change more than 3.2 millivolts (0.0032 v) for a change from no-load to full-load. If the load were to be connected by only 12 inches of #12 gage wire in each lead, at full-load the total drop across the resistance in these wires would amount to 16 millivolts, equivalent to 5 times the voltage change within regulation. The regulation measured at the load would be 0.05% while at the terminals it would measure 0.01%.

Instrumentation. -

1. Line Voltage. - By definition, load regulation is specified, and measured with a condition of constant line voltage. A constant voltage transformer or other source of constant AC is required. If the AC source is also adjustable it can be used to vary or step the line voltage input for measuring Line Regulation.

2. Load. - An accurate full-load is required, preferably one that can be conveniently applied, or stepped on and off by some switching means.

3. Measurement. - Any instrument may be used that is capable of measuring both the absolute value of the output voltage, and the small magnitude of change in the output voltage occurring as the line or load changes are applied.

a. A differential voltmeter may be used; or a power supply analyzer such as the Kepco Regulation Analyzer Model 901C which gives measurements directly in percentage.

b. A DC coupled oscilloscope may be used, if a suitable auxiliary DC voltage is available to buck-out the voltage under test so that only the net change can be measured. The buck-out voltage must be at least equal in magnitude to, and have a greater order of regulation than the voltage under test.

Procedure. -

1. On Supplies that have more than one set of output terminals (most Kepco Supplies have terminals on the front and the rear) measurement can be made at either set, except on those Supplies where the regulation is specified for one particular set of terminals. In any case, both the load and the measuring instrument should be connected to the same terminals.

2. To avoid terminal losses giving erroneous measurements, on each output terminal connect the load to one end and the instrument to the other end of a short length of #14 bus wire looped around the terminal, as shown in Fig. 4-1.

3. The Supply should not be set up for Remote Error sensing where this facility is provided. Error Sensing jumpers to the output terminals, where employed, should be securely in place.

....RIPPLE MEASUREMENT.

Any AC ripple component present in the DC output of a properly functioning Power Supply will be small in magnitude, on the order of millivolts. It is usually stated in the specifications for the Supply either in millivolts RMS or in percentage (in RMS) of the output voltage. Because of its small magnitude, a sensitive instrument must be used to measure the ripple, and care must be exercised in order to obtain accurate readings.

1. Be certain that the input to the measuring instrument contains a blocking capacitor to isolate the DC voltage from the ripple component, and that the DC voltage rating of the capacitor is sufficiently high for the DC output voltage that will be applied.

2. Some rectifier types of AC meters do not contain a DC blocking capacitor, and DC current will pass through the rectifier to the meter movement. In such cases, or where the internal capacitor does not have a high enough DC rating, a 0.1 μf capacitor (with sufficiently high DCWV) connected in series with the high side of the input will insure isolation of the DC from the ripple.

3. Interconnecting leads between the Power Supply and the instrument should be short and preferably shielded to prevent stray AC pickup. When using a measuring instrument that is connected to the same power line, be certain to have good connections in the interconnecting leads to avoid the introduction of a ground loop.

CONNECTIONS FOR REGULATION MEASUREMENT

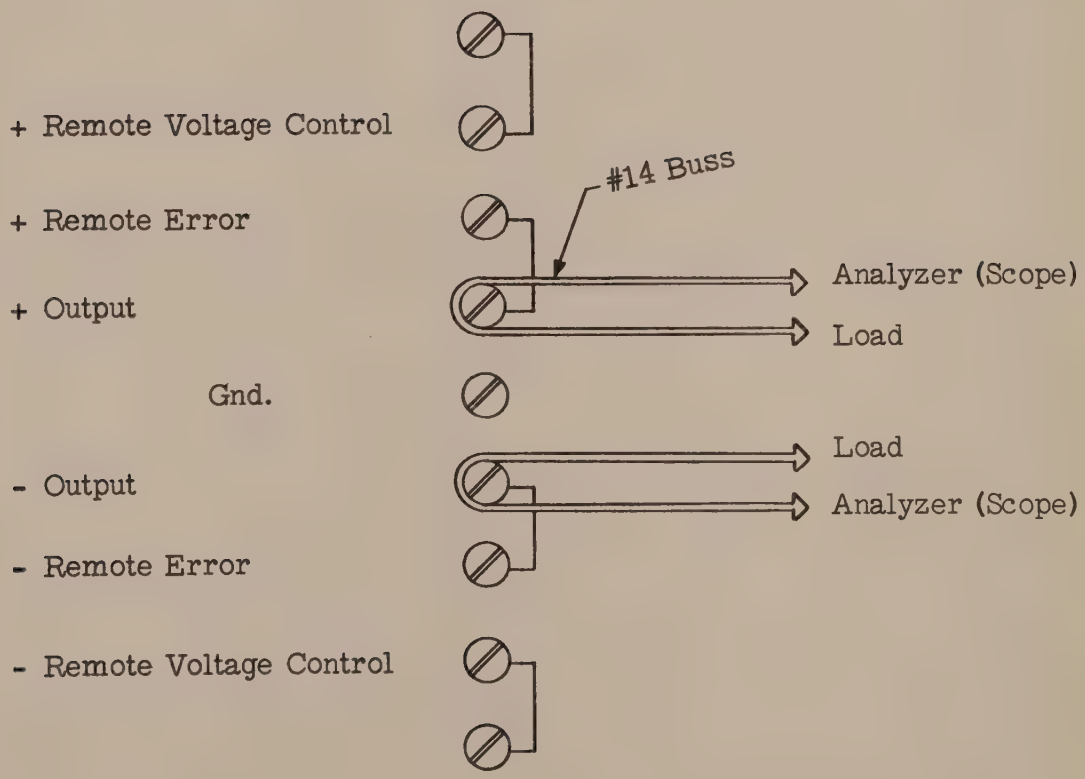


Fig. 4-1 Connections for Measuring Regulation

PARTS LIST OF POWER UNIT - MODEL SC-32-15A

DRAWING S-SC-32-15A-02

B201	- Fan		
C101	- 1	MF	200 WV
C201 thru C206	- 2400	MF	65 WV
C207 thru C209	- 4000	MF	50 WV
C210	- 0.1	MF	500 WV
C211 thru C214	- 0.5	MF	200 WV
C301	- 500	MF	12 WV
C302	- 500	MF	12 WV
C303	- 350	MF	50 WV
C304	- 100	MF	150 WV
C305	- 0.4	MF	200 WV
C306	- 0.4	MF	200 WV
C401	- 10	MF	150 WV
C402	- 0.22	MF	200 WV
C403	- 10	MF	150 WV
CR201	- Silicon Rectifier 4T1015B1S1		
CR301 thru CR306	- Germanium Rectifier 1N91		
CR307 thru CR310	- Silicon Rectifier PT-5		
CR401 and CR402	- Silicon Rectifier PT-5		
F101	- 15 Amp. Fuse		
F201	- 1/4 Amp. Fuse		
F202	- 1-1/2 Amp. Fuse		
M101	- Meter, 0-15 A DC		
M102	- Meter, 0-50 V DC		
PL101	- Neon Pilot Light NE-51		
Q301	- Transistor 2N382 (Alternate 2N383)		
Q901 thru Q931	- Transistor 2N441-10		
R101	- 10	K	10 turn Pot.
R201	- .033	Ohm	15 watt
R202	- 250	Ohm	40 watt WW
R203	- 100	Ohm	40 watt WW
R204	- 500	Ohm	20 watt WW

PARTS LIST - MODEL SC 32-15A

DRAWING S-SC 32-15A-02

R205	- 10	Ohm	20 watt WW
R206	- 500	Ohm	20 watt WW
R207 and R208	- 47	Ohm	1/2 watt
R301	- 30	Ohm	3 watt WW
R302	- 470	Ohm	1/2 watt
R303	- 2	K	2 watt
R304	- 3.3	K	1/2 watt
R305	- 47	Ohm	1/2 watt
R306	- 430	Ohm	1/2 watt
R401	- 82	K	1/2 watt
R901 thru R930	- 1.5	Ohm	3 watt WW

RL201	- 4PDT Relay
RL202	- SPDT Relay
S101	- SPST Switch
S901	- Thermoswitch N. C.
T101	- Powerstat Type Q116U
T201	- Kepco #100-1143
T202	- Kepco #100-1142
T203	- Kepco #100-1039
TB201	- Jones #8-142-Y

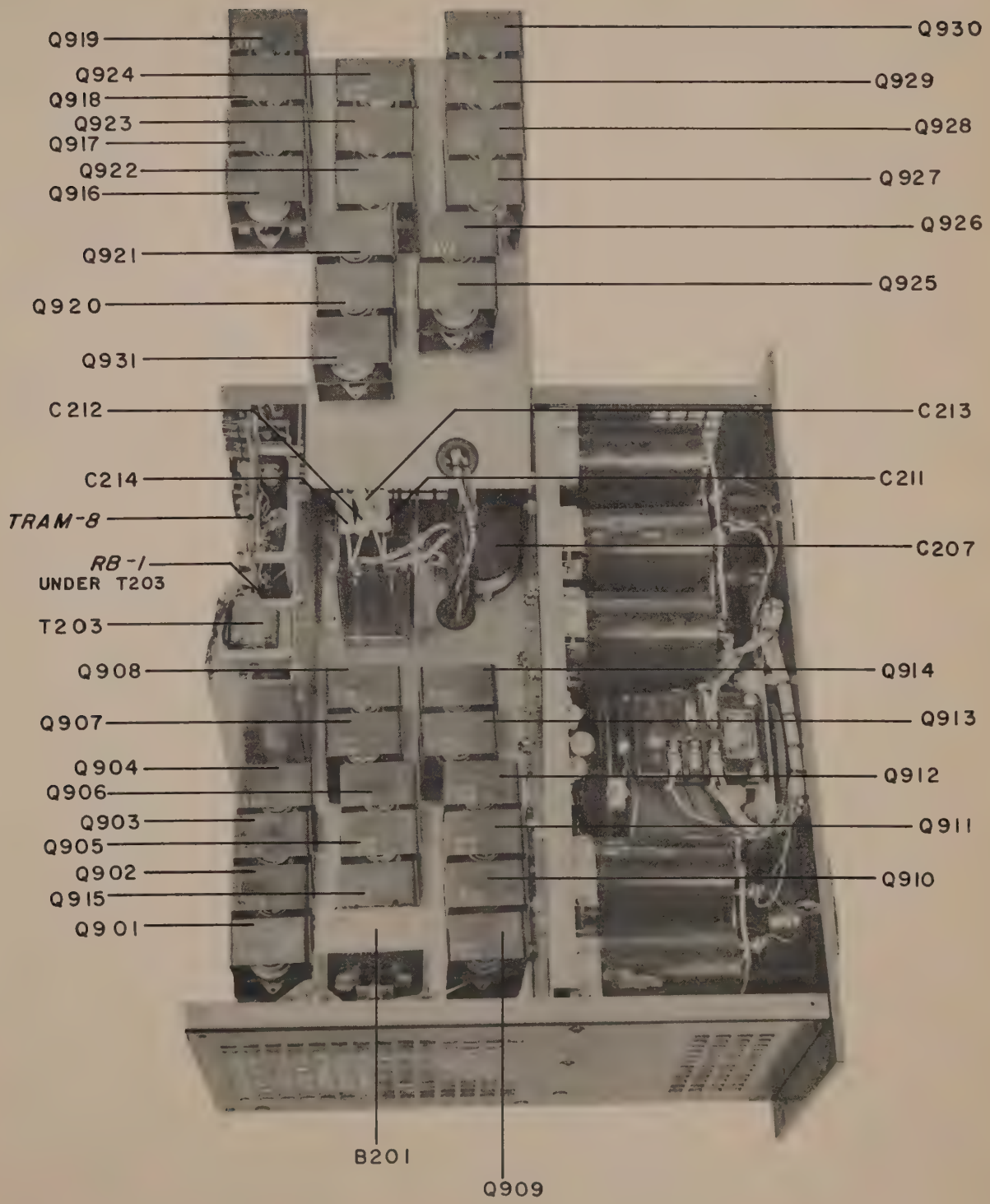
Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
		Capacitors:			
C1	117-0105	Electrolytic, Pigtail Type	25 µf 25 v +100, -10%	Industrial Cond.	1B1063
C2	117-0129	Mylar	2 µf 200 v 10%	Hopkins Eng.	2P2MK
C3	117-0128	Mylar	0.4 µf 200 v 10%	Hopkins Eng.	P42MK
C4	117-0087	Ceramic	0.1 µf 500 v + 80, -20%	Sprague	41C92
Q1	119-0016	Transistor, PNP		Delco	119-0016
Q2, 3, 4, 5, 6, 8, 12, 11	119-0022	Transistor, PNP		Tung-Sol	2N382
Q7	119-0007	Transistor, NPN		Gen. Transistor	2N35
Q9, 10	119-0024	Transistor, NPN		Gen. Transistor	GT1092
		Resistors:			
R1	115-0439	Fixed, Molded	3.3 K Ω 1/2 w 10%	Allen-Bradley	EB3321
R2	115-0466	Fixed, Molded	2.2 K Ω 1/2 w 10%	Allen-Bradley	EB2221
R3, 4, 11	115-0459	Fixed, Power, Axial	500 Ω 3 w 5%	Ward Leonard	3X500
R5, 15, 22	115-0467	Fixed, Molded	4.7 K Ω 1/2 w 10%	Allen-Bradley	EB4721
R6, 7, 10	115-0469	Fixed, Power, Axial	2.5 K Ω 3 w 5%	Ward Leonard	3X2500
R8	115-0460	Fixed, Power, Axial	10 K Ω 3 w 5%	Sprague	151E-10K
R9	115-0473	Fixed, Molded	1.8 K Ω 1/2 w 10%	Allen-Bradley	EB1821
R12	115-0736	Fixed, Precision	1.8 K Ω 1/2 w 1%	Dale	WS-1/2
R13, 14	115-0471	Fixed, Power, Axial	100 Ω 3 w 5%	Ward Leonard	3X100
R16	115-0371	Fixed, Molded	220 Ω 1/2 w 10%	Allen-Bradley	EB2211
R17	115-0502	Fixed, Molded	10 Ω 1/2 w 10%	Allen-Bradley	EB1001
R18	115-0547	Fixed, Molded	1 K Ω 1/2 w 10%	Allen-Bradley	EB1021
R19	115-0782	Fixed, Molded	1.6 K Ω 1/2 w 5%	Allen-Bradley	EB1625
R20	115-0560	Fixed, Molded	2.7 K Ω 1/2 w 10%	Allen-Bradley	EB2721

Schematic Part No.	Kepco Part No.	Description	Specifications	Mfr.	Mfr's. No.
		Resistors:			
R21	115-0783	Fixed, Molded	300 Ω 1/2 w 5%	Allen-Bradley	EB3015
R23	115-0718	Fixed, Molded	45 Ω 1/2 w 10%	Allen-Bradley	EB4501
R24	115-0474	Fixed, Molded	4.7 Ω 1/2 w 10%	Allen-Bradley	EB47G1
R25	115-0600	Variable, Composition	300 Ω 2 w 10%	Allen-Bradley	JA1L040S301UZ
R26	115-0803	Fixed, Power, Axial	200 Ω 3 w 5%	Ward Leonard	3X200
RD1	121-0001	Zener Diode		Hoffman	1N429

FIELD REPLACEMENT LIST

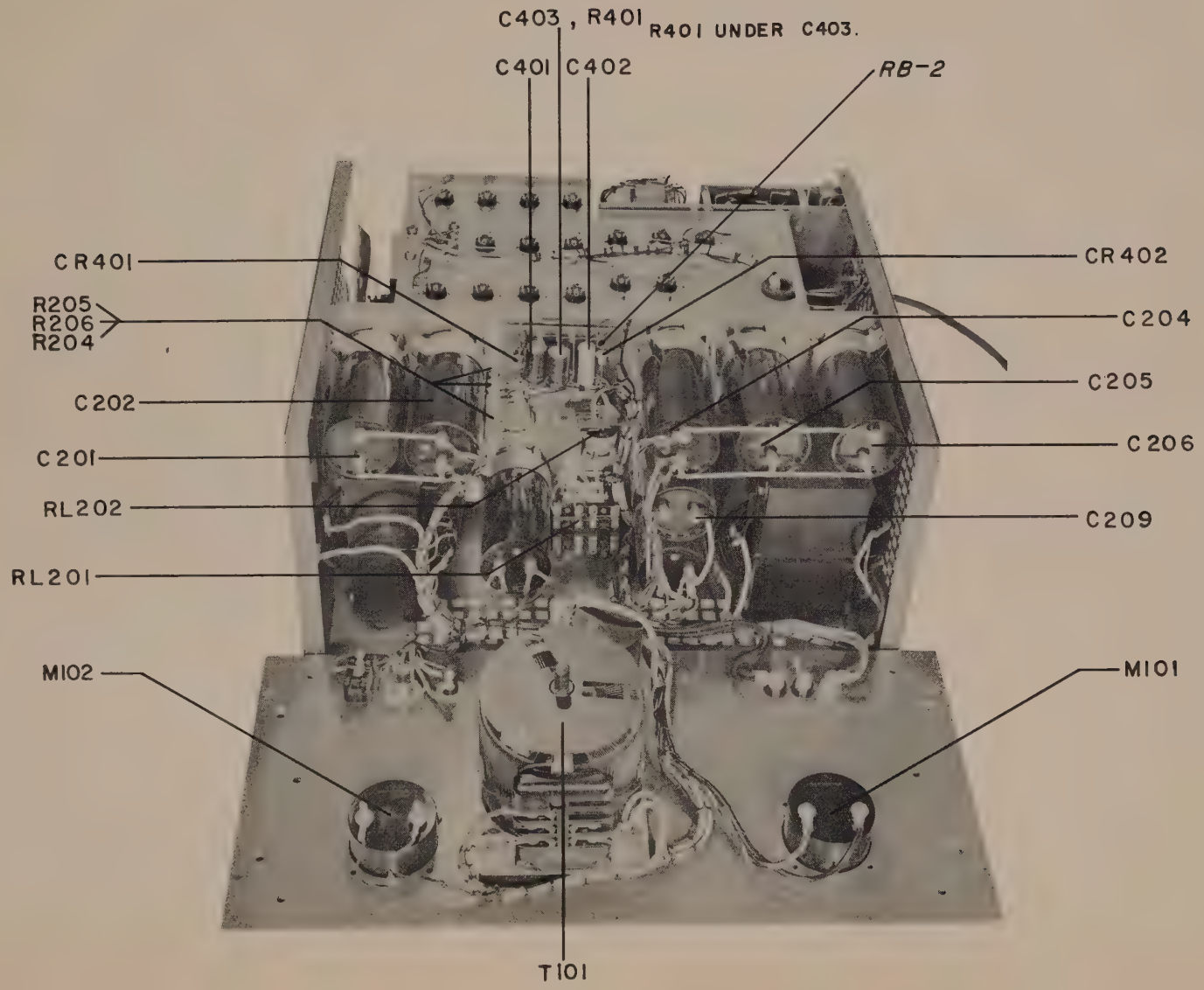
Kepco Part No.	Description	Recommended Replacement MFR.	Mfr. No.
119-0003 119-0016	Transistor PNP	Delco	2N174
119-0022	Transistor PNP	Tung-Sol	2N382 2N1707
119-0034	Transistor PNP	Delco	2N1172
119-0035, 0036,0037	Transistor PNP	Motorola Clevite	2N1167 CTP 3553
119-0048	Transistor Unijunction	General Elec.	2N1671A
119-0020	Transistor PNP	RCA	2N398A
119-0038	Silicon NPN	Transitron	ST29
119-0004	Transistor PNP	Delco	2N277
119-0024	Transistor NPN	Gen. Instrument RCA Sylvania	2N1605 2N388 2N1308

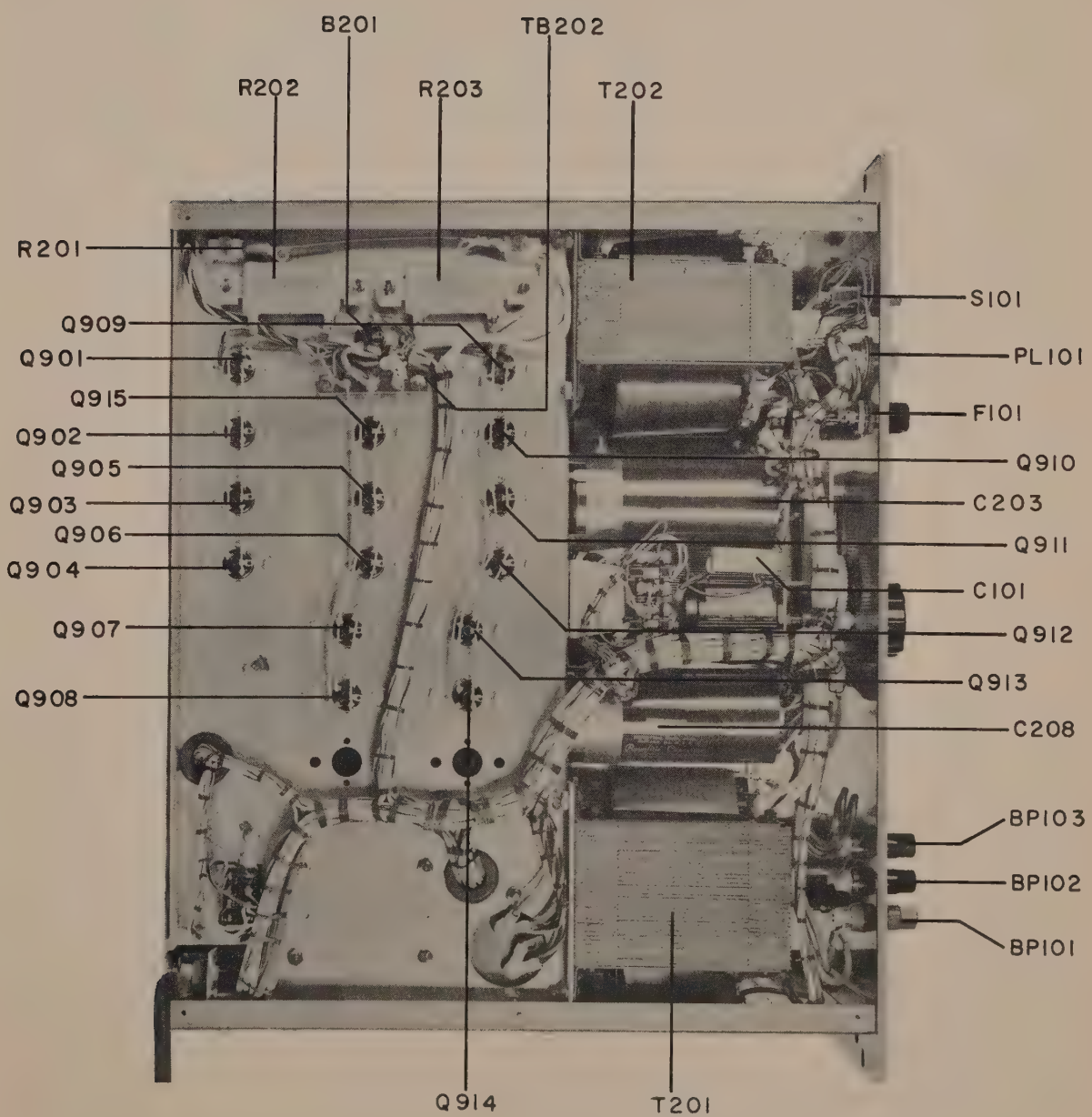
SC-32-15A


Q919
Q924
Q918
Q923
Q917
Q922
Q916
Q921
Q920
Q931
C212
C214
TRAM-8
RB-1
UNDER T203
T203
Q908
Q907
Q904
Q906
Q903
Q905
Q902
Q915
Q901
B201
Q909
Q930
Q929
Q928
Q927
Q926
Q925
C213
C211
C207
Q914
Q913
Q912
Q911
Q910

TOP

SC-32-15A
INTERIOR



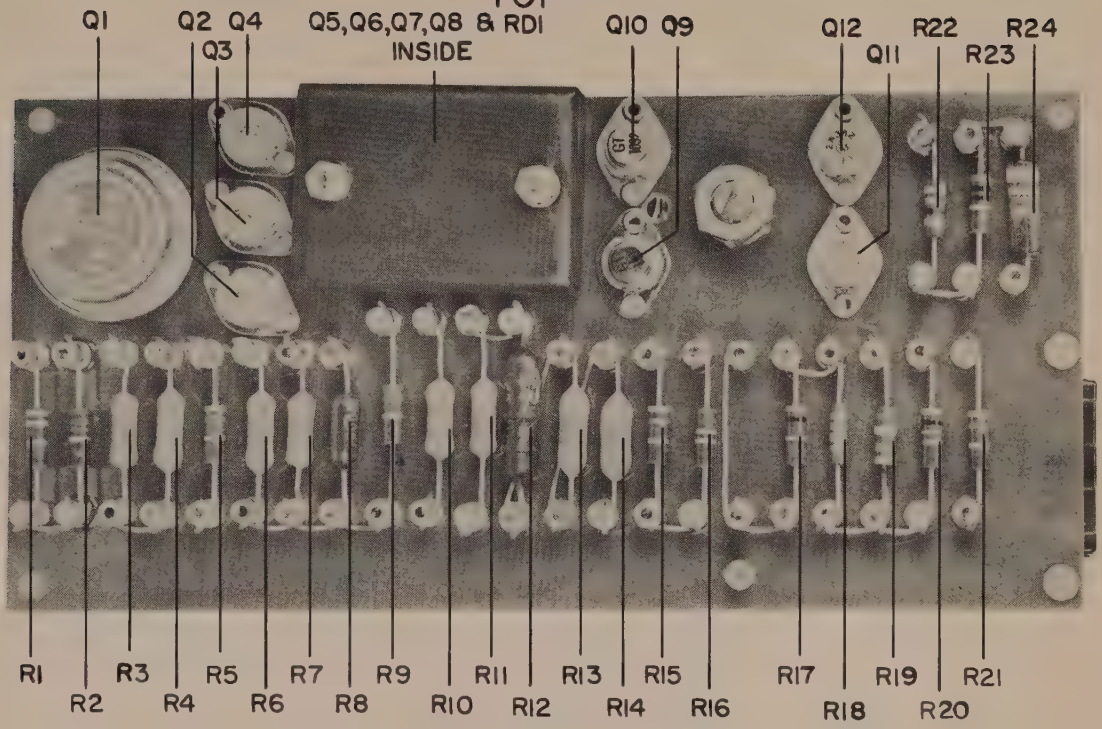


SC-32-15A

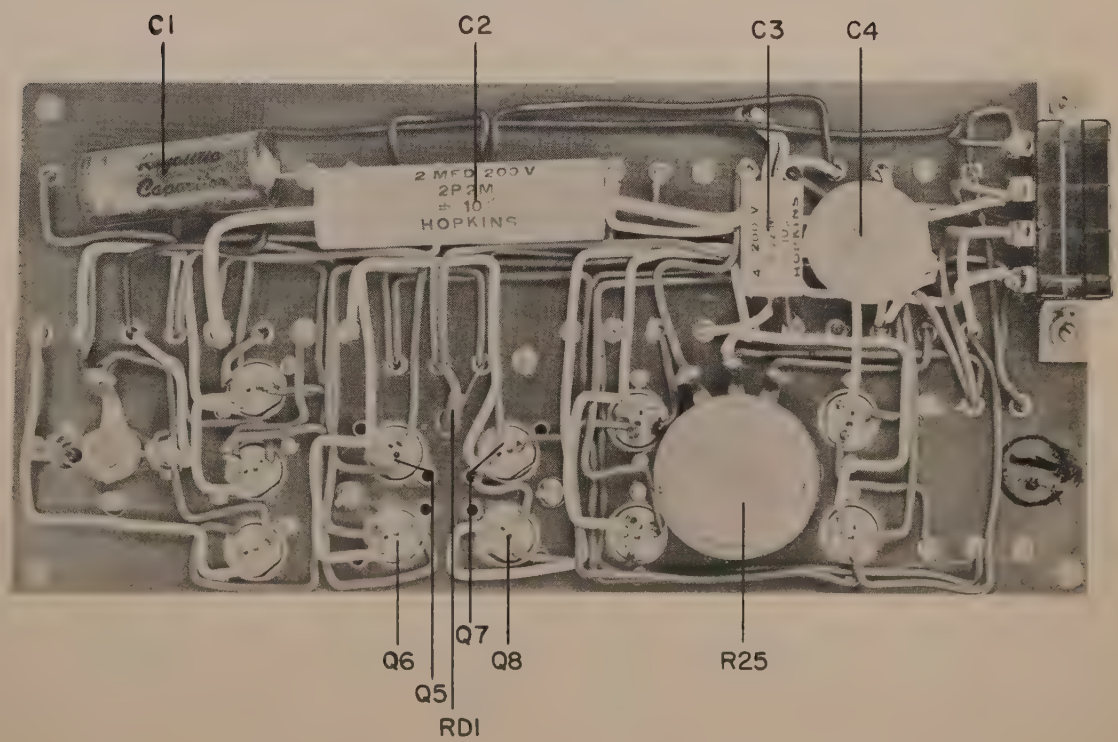
BOTTOM

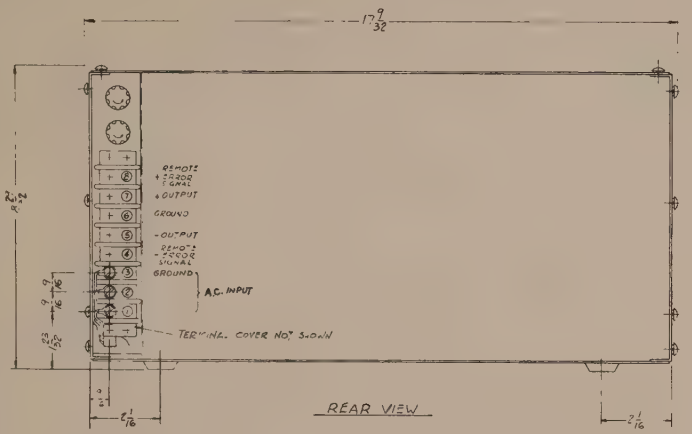
TRAM 8

TOP

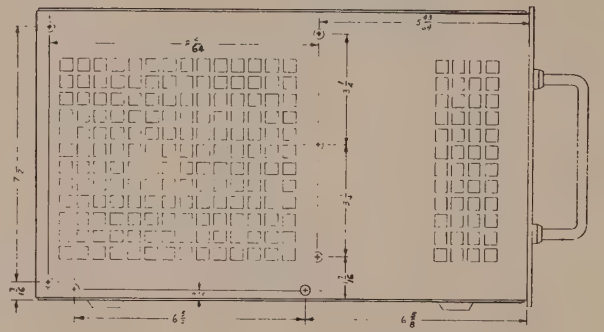


BOTTOM

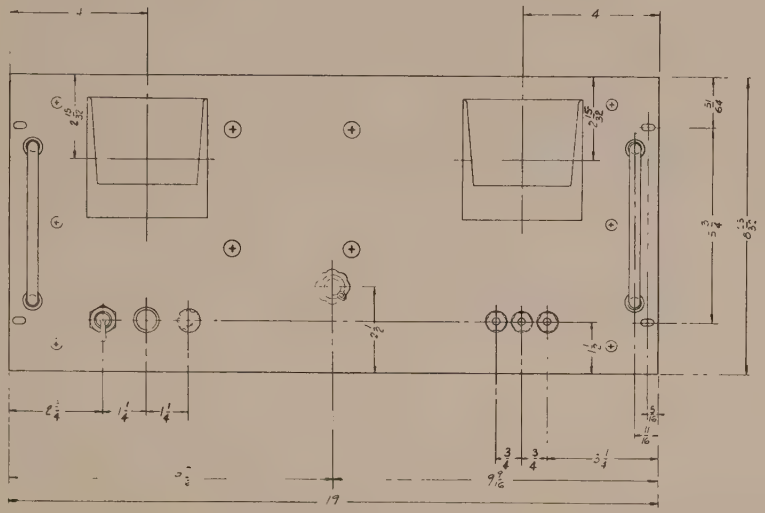




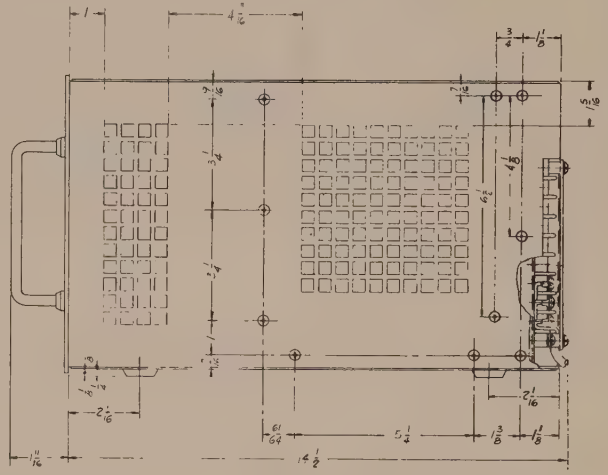
REAR VIEW



LEFT SIDE VIEW



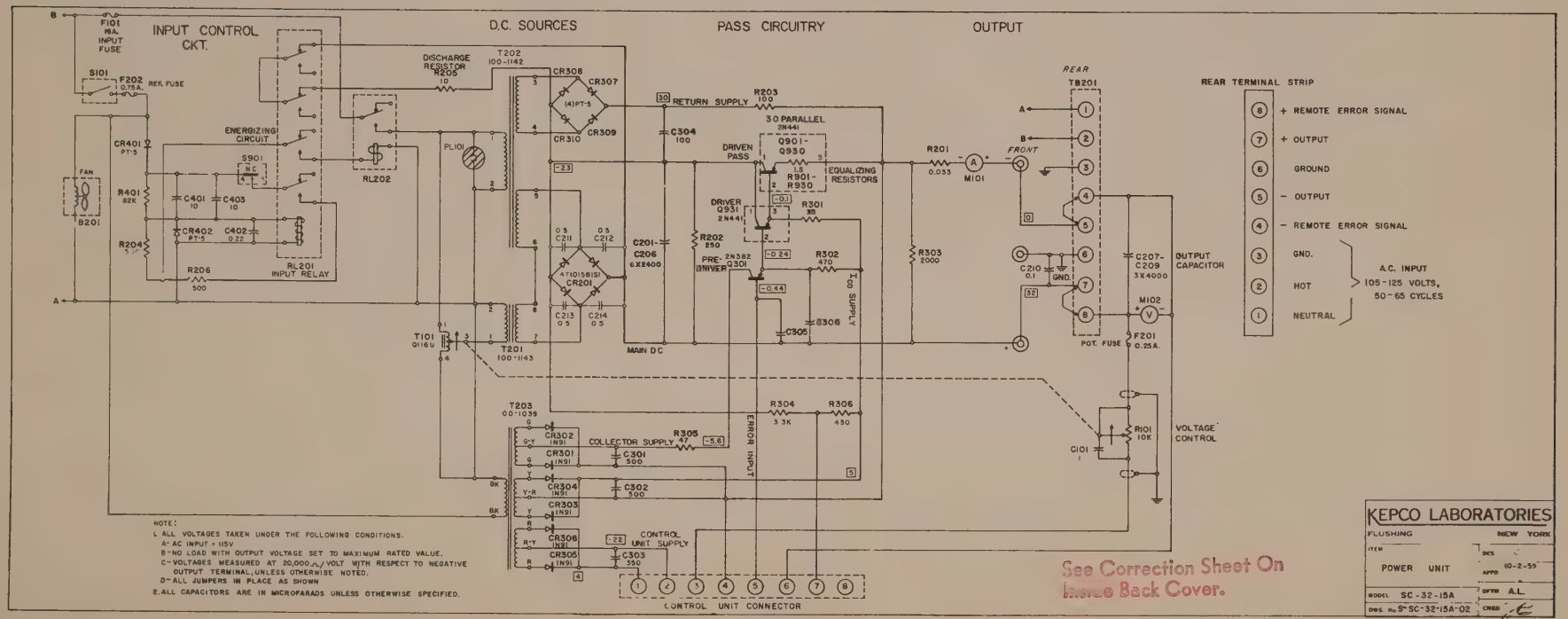
FRONT VIEW



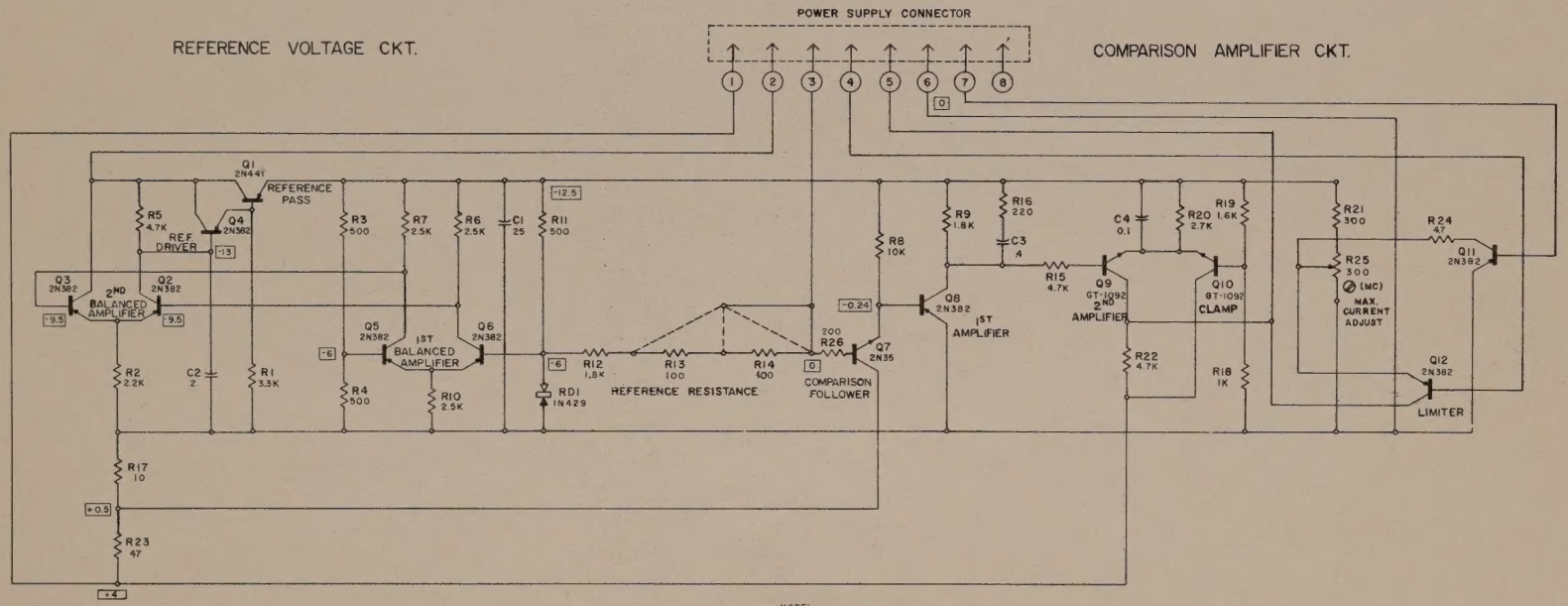
RIGHT SIDE VIEW

THIS DWG. USED ON MDL'S
SC-32-10A
SC-300-1
SC 60-5
SC-32-13A

KEPCO LABORATORIES			
FLUSHING		NEW YORK	
ITEM: OUTLINE DRAWING	DES:	CHKD: J.B.	
	APPD: Y.X.	SCALE:	
	DFTR: A.C.S.	DATE: 4-9-59	
MODEL: SC-B 3/4 SERIES	FINISH:		REV NO
DWG NO: CM00594	KEPCO NO:		


INPUT CONTROL CKT.
D.C. SOURCES
PASS CIRCUITRY
OUTPUT
F101 8A. INPUT FUSE
S101
F202 0.75A.
REF. FUSE
ENERGIZING CIRCUIT
S901
CR401 PT-5
FAN
B201
R401 82K
C401 10
C403 10
CR402 PT-5
C402 0.22
R204 5.1K
R206 500
RL201 INPUT RELAY
RL202
DISCHARGE RESISTOR R205 10
T202 100-1142
CR308
CR307
(4) PT-5
CR310
CR309
PL101
C211 0.5
C212 0.5
C213 0.5
C214 0.5
CR201 4 TI015B/IS1
T101 Q116U
T201 100-1143
MAIN DC
C201-C206 6X2400
RETURN SUPPLY
R203 100
C304 100
30 PARALLEL 2N441
Q901-Q930
R901-R930
EQUALIZING RESISTORS
DRIVEN PASS
DRIVER Q931 2N441
R301 33
R202 250
PRE-DRIVER 2N382 Q301
R302 470
C305
R303 2000
R201 0.033
M101
FRONT
REAR
T8201
C210 0.1
GND.
C207-C209 3X4000
OUTPUT CAPACITOR
M102
F201 0.25A.
POT. FUSE
REAR TERMINAL STRIP
8 + REMOTE ERROR SIGNAL
7 + OUTPUT
6 GROUND
5 - OUTPUT
4 - REMOTE ERROR SIGNAL
3 GND.
2 HOT
1 NEUTRAL
A.C. INPUT 105-125 VOLTS, 50-65 CYCLES
T203 00-1039
CR302 IN91
CR301 IN91
CR304 IN91
CR303 IN91
CR306 IN91
CR305 IN91
COLLECTOR SUPPLY
R305 47
C301 500
C302 500
C303 350
CONTROL UNIT SUPPLY
R304 3.3K
R305 430
ERROR INPUT
R101 10K
C101
VOLTAGE CONTROL
CONTROL UNIT CONNECTOR
NOTE:
1. ALL VOLTAGES TAKEN UNDER THE FOLLOWING CONDITIONS.
A- AC INPUT = 115V
B-NO LOAD WITH OUTPUT VOLTAGE SET TO MAXIMUM RATED VALUE.
C-VOLTAGES MEASURED AT 20,000Ω/VOLT WITH RESPECT TO NEGATIVE OUTPUT TERMINAL, UNLESS OTHERWISE NOTED.
D-ALL JUMPERS IN PLACE AS SHOWN
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
See Correction Sheet On Inside Back Cover.
KEPCO LABORATORIES
FLUSHING NEW YORK
ITEM POWER UNIT
DES
APPD 10-2-59
MODEL SC-32-15A
DFTR A.L.
DWG No. SK-SC-32-15A-02
CHKD

ORDER REPLACEMENT PARTS BY KEPCO PART NUMBER
PROVIDED IN PARTS LIST SECTION



NOTE:
1. ALL VOLTAGES TAKEN UNDER CONDITIONS SPECIFIED ON MAIN SCHEMATIC.
2. ALL CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
3. REFERENCE RESISTANCE MAYBE R12 IN COMBINATION WITH EITHER OR BOTH OF R13, R14.

KEPCO LABORATORIES
FLUSHING NEW YORK

ITEM: CONTROL UNIT	DES
	APPV 11-16-59
MODEL: TRAM 8	DFTM A.L.
DWG No. S-TRAM 8-01	CHKD

CORRECTION SHEET FOR INSTRUCTION MANUAL

MATERIAL AFFECTED

Power Unit Schematic

CORRECTION

Add the following:

1. Resistor R207, 47 Ω from (+) Remote Error Signal to (+) Output terminals.

2. Resistor R208, 47 Ω from (-) Remote Error Signal to (-) Output terminals.

Physical location: on back of rear terminal strip.

3. Change F202, fuse, from .75A to 1.5A.

131-38 SANFORD AVENUE • FLUSHING 52, N. Y. • Area Code 212 IN 1-7000 • TWX # NY 4-5196

146-0045 - 1/62 -12M